Speech Reception Threshold Measurement Using Automatic Speech Recognition

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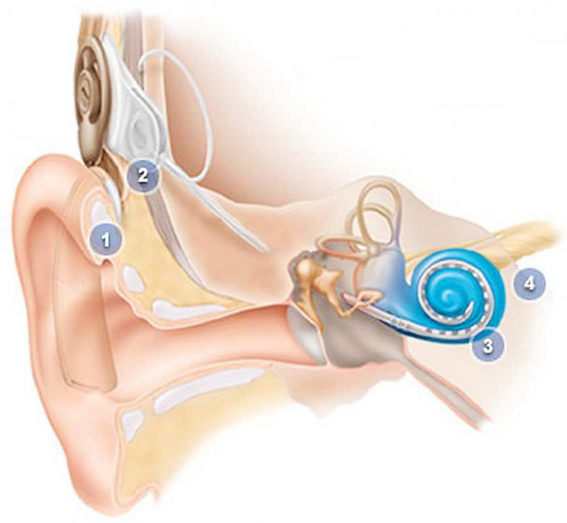
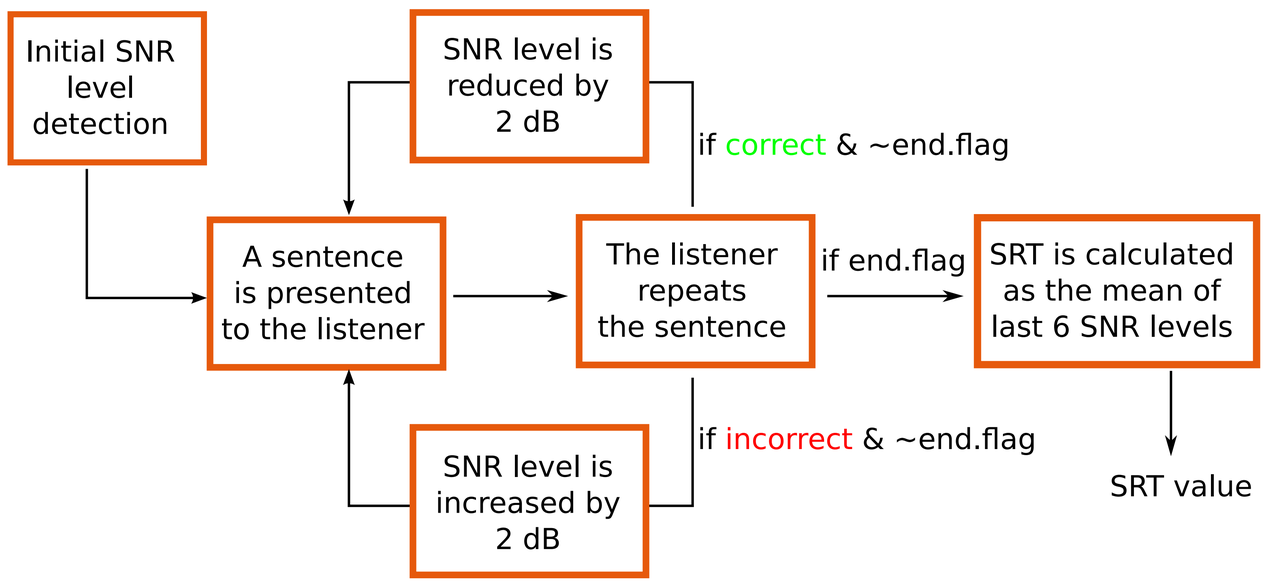
1. Introduction

- Hearing tests: quantify the hearing abilities of people with both normal hearing and hearing impairments
- **Speech reception threshold (SRT)**: SNR level at which the speech recognition rate of a person is 50%
  - Evaluating a listener's hearing capabilities and diagnosing hearing loss
  - Adjusting the CI parameters and analyze the impact of new developments in CI devices
  - Provides useful data for psychoacoustic research
- **Goal:** Automating SRT measurement procedure using ASR technology
  - To reduce human effort which can be invested in more vital tasks
  - Objective and repeatable assessment without observer bias



2. SRT Measurement

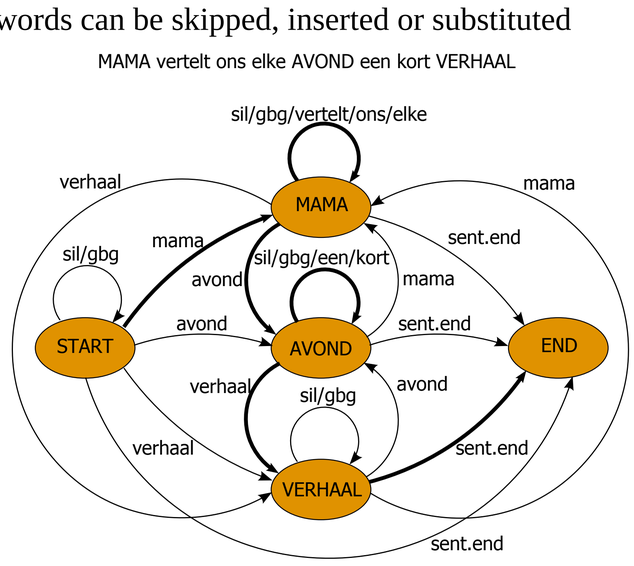
- Repeated tests of up-down type performed by an audiologist
- Several Dutch speech tests: LIST-tests, NVA-tests
- LIST-tests: 10 sentences, each containing 2-5 keywords
- SRT measurement procedure:
  - Words or sentences embedded in different levels of noise presented to the listeners
  - Listeners are asked to repeat what they heard



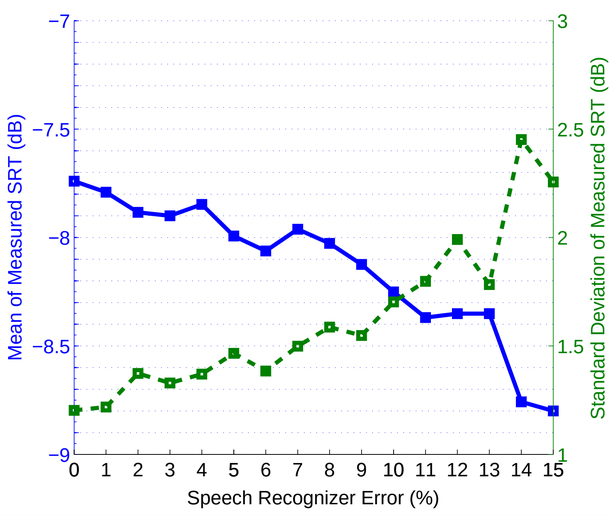
- In this work, the evaluation of listener response is performed by an automatic speech recognizer
- This is feasible as the recognizer makes significantly fewer errors than the listener with a recognition error around 50% by definition.

3. Automatic Evaluation Scheme

- ASR overview: two-layered recognition structure
  - 1st layer: a phone recognizer generates a phone lattice using general models
  - 2nd layer: decoding using task-dependent information
- Task-dependent language models: finite state grammars (FSG)
  - As the sentences are known in advance, using FSGs is feasible for this recognition task
  - Listeners are only scored on the keywords in the sentence
  - Keywords can be repeated in any order
  - Non-keywords can be skipped, inserted or substituted

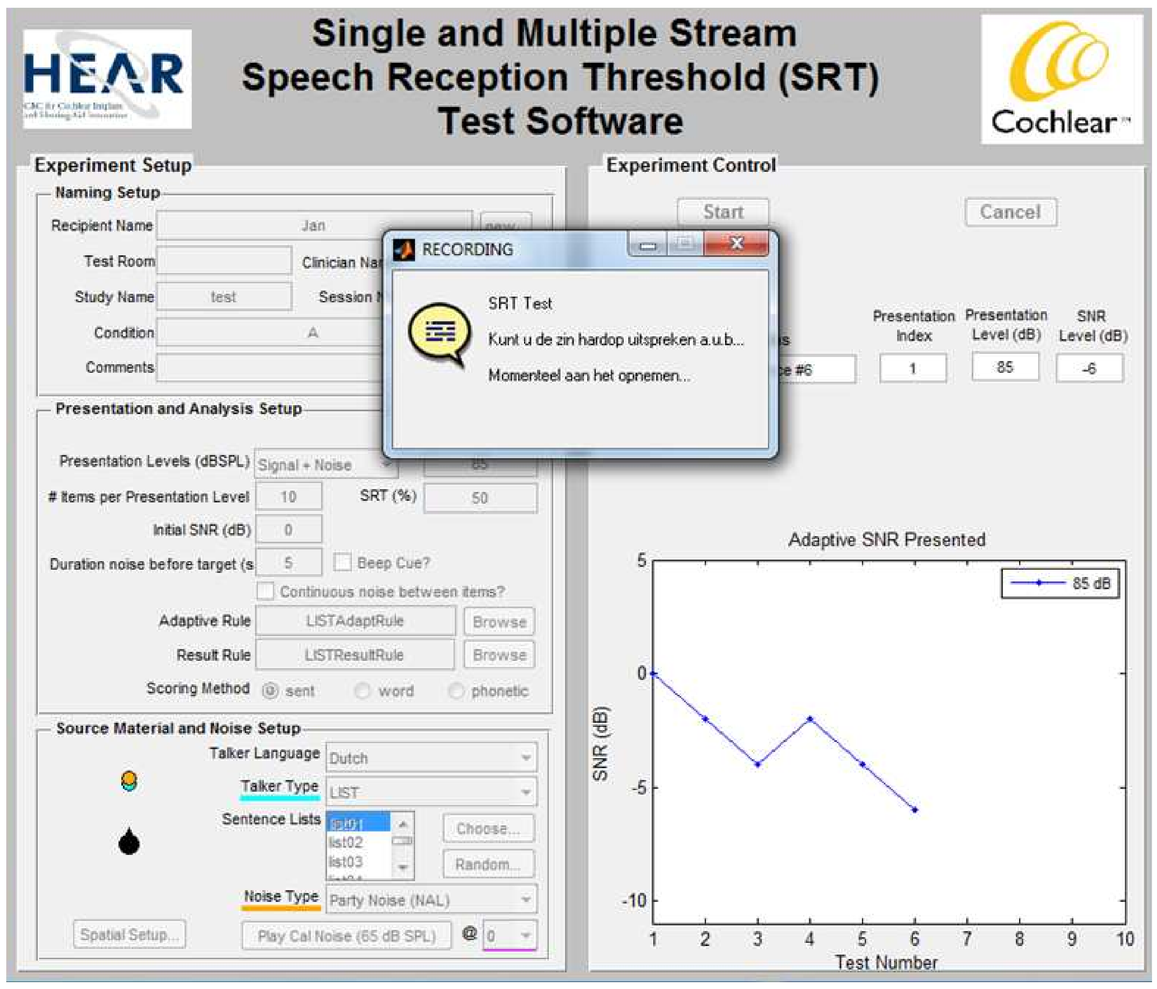


- The initial experimental findings towards such an automated system using an automatic speech recognizer [1]



4. Implementation

- The manual SRT measurement software has been described in [2]
- The software is modified in a way that patient responses are recorded for a variable duration depending on the duration of the presented sentence
- Recording is sent via HTTP to a RESTful web service performing the keyword detection
- A demonstration of the automatic SRT measurement procedure is available in `http://www.esat.kuleuven.be/psi/spraak/demo/srt/`



5. References

[1] H. Deprez, E. Yılmaz, S. Lievens, and H. Van hamme, "Automating speech reception threshold measurements using automatic speech recognition," In Proc. 4th SLPAT Workshop, pp. 35-40, Grenoble, France, Aug. 2013.
[2] P. W. Dawson, S. J. Mauger, and A. A. Hersbach, "Clinical evaluation of signal-to-noise ratio-based noise reduction in nucleus cochlear implant recipients," Ear and Hearing, 32(3):382-390, 2011.